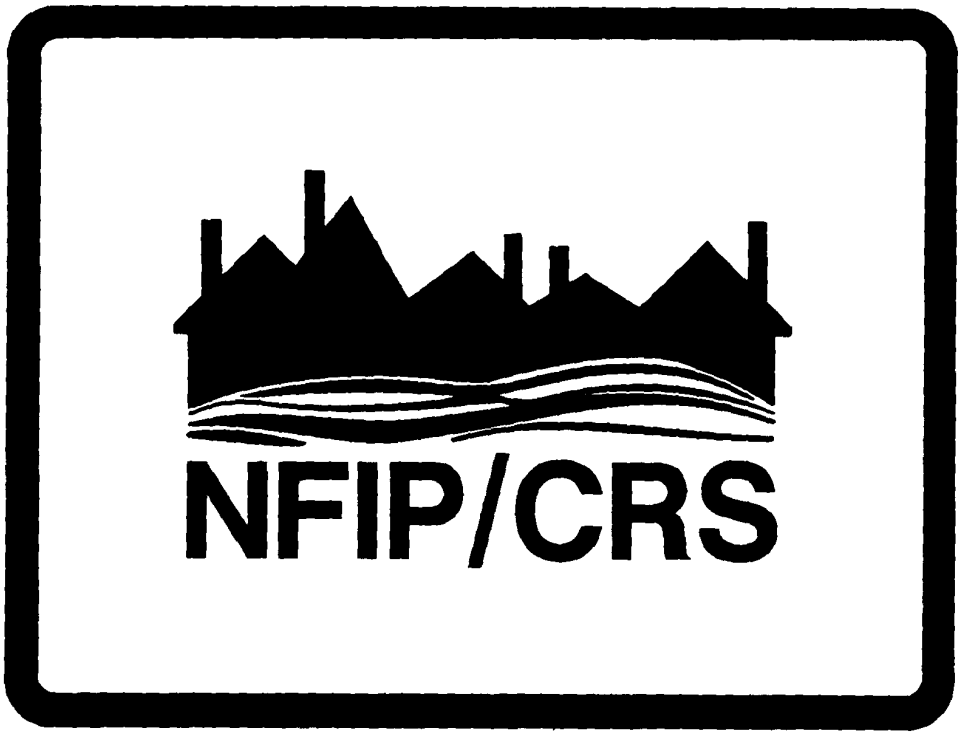
FEDERAL EMERGENCY MANAGEMENT AGENCY

National Flood Insurance Program
Community Rating System



CRS COMMENTARY SUPPLEMENT FOR SPECIAL HAZARDS CREDIT

January 1999

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A community interested in more information on obtaining flood insurance premium credits through the Community Rating System (CRS) should have the *CRS Application*. This and other publications on the CRS are available at no cost from:

Flood Publications
NFIP/CRS
P.O. Box 501016
Indianapolis, IN 46250-1016
(317) 848-2898
Fax: (317) 848-3578

400SH CRS CREDIT FOR SPECIAL HAZARD AREAS

A number of flood hazards are not fully addressed in the National Flood Insurance Program (NFIP), either from a regulatory or an insurance standpoint. They include uncertain flow path flood hazards, flooding adjacent to closed basin lakes, ice jam flooding, mudflow hazards, preserving coastal dunes and beaches, flooding affected by land subsidence, coastal erosion, and tsunamis.

This publication discusses the credits provided by the Community Rating System (CRS) for mapping and management of these special hazards. It is a supplement to the *CRS Coordinator's Manual*. Changes from the previous edition are shown with vertical lines (▌) in the margins.

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401SH Introduction

The Federal Emergency Management Agency (FEMA) and many communities in the United States have long recognized that the mapping and regulatory standards of the NFIP do not adequately address all of the flood problems in the country. The special hazards for which CRS credit is provided are among those for which it is most difficult to derive standard techniques. Until techniques are developed that can be applied uniformly and fairly throughout the country, the CRS provides credit to those communities that have developed viable mapping and regulatory standards for the special hazards within their jurisdictions.

In an effort to provide credit for as many community programs as possible, mapping and regulatory standards for these special hazards often are based upon results rather than upon specific techniques or criteria. As a result, a separate technical review process is used to verify special hazards credit. Communities may be requested to provide additional documentation on their programs, and a specialist in mapping and managing the special hazard may contact the community.

The following is a brief summary of the research findings on the nature of the hazards, mapping and management techniques being used across the country, and the goals of the mapping and regulatory standards for which CRS credit is offered.

a. Uncertain Flow Path Hazards

In earlier CRS documents, flood hazards related to alluvial fans and moveable bed streams were discussed separately. As a result of the publication by the National Research Council in 1996 of a report entitled, *Alluvial Fan Flooding*, these two hazards are being combined into a single hazard called "uncertain flow path" flooding. This change in itself does not cause any change in the CRS credit provided to communities that map and regulate these hazards.

Alluvial fans occur where there are steep gradients from the sources of sediment to the depositional areas, where the source areas are rich in sediments, and where precipitation is not sufficient to carry the sediments downstream as rapidly as they accumulate. In the United States, these conditions exist primarily in the arid and semi-arid regions west of the Great Plains, although there are also fans in Alaska, Kentucky, Tennessee, and West Virginia. They are most commonly found in Arizona, California, Idaho, Montana, Nevada, New Mexico, Utah, Washington, and Wyoming.

Alluvial fan flood hazards are those that result from moving water, sediment, and debris that occur at specific places on an alluvial fan rather than across the entire geologic feature. A river valley is evidence of certain types of flood hazards; an alluvial fan is evidence of certain other flood hazards.

Mitigation of flood hazards on alluvial fans must respond to the three components of the hazard: the velocity of the water, sediment, and debris; the volume and movement of sediment and debris during floods; and the potential for channel migration across the fan (avulsions) during floods.

Erosion and sedimentation are factors in the delineation and regulation of almost all riverine floodplains. However, in many rivers and streams these processes are relatively predictable and steady. In other streams, sedimentation and scour are major processes during a flood, and often have a larger impact on the extent of flooding and flood damage than the peak flow.

Extreme cases of sedimentation and erosion are a result of both natural and human-induced processes. They frequently occur in the West, where relatively recent tectonic activity has left steep slopes. They occur in the more arid parts of the country, where rainfall and streamflow are infrequent, and also where recent and rapid development has disturbed the natural processes of sediment production and transport.

For the purpose of determining CRS credit, moveable bed streams include streams where erosion (degradation of the streambed), sedimentation (aggradation of the streambed), or channel migration during a flood causes a change in the topography of the stream sufficient to change the flood elevation or the delineation of the floodplain or floodway. In some cases, these processes may occur simultaneously, or one process may occur in one flood event and another process in a subsequent event. CRS credit for regulating moveable bed streams generally requires a study of the sources of sediment, changes in those sources, and the impact of sediment transport through the floodplain.

b. Closed Basin Lakes

Two types of lakes pose special hazards to adjacent development: lakes with no outlets, like the Great Salt Lake and the Salton Sea; and lakes with inadequate, regulated, or elevated outlets, such as the Great Lakes and many glacial lakes. These are referred to as “closed basin lakes.” Closed basin lakes are subject to very large fluctuations in elevation that can persist for weeks, months, or years.

Closed basin lakes occur in almost every part of the United States for a variety of reasons. Lakes in the northern tier of states and Alaska were scoured out by glaciers. Lakes with no outlets (playas) formed in the West as a result of tectonic action. Oxbow lakes along the Mississippi and other large rivers are a consequence of channel migration. Sinkhole lakes formed where there are large limestone deposits at or near the surface and adequate surface water and rainfall to dissolve the limestone (karst topography).

Determination of the long term flood elevation for a closed basin lake is the primary concern of CRS credit for mapping. In regulation, recognition of the hazards posed by long term inundation is required for CRS credit.

c. Ice Jam Hazards

Ice jams form in a variety of ways and at different times during the winter. Damage from ice jam flooding often exceeds that of clear water flooding because of higher surface elevations, rapid increases in flood elevations, and physical damage caused by moving ice chunks.

Ice jam flooding occurs in as many as 35 states, especially in Alaska, Idaho, Illinois, Iowa, Maine, Minnesota, New Hampshire, Oregon, Vermont, and Washington. Research on the formation and nature of ice jams has accelerated in the last 30 years, but there remains a great deal of uncertainty in predicting the location, time, and size of ice jams. It is known that certain natural and human-built features in stream reaches increase the probability of ice jam formation at specific locations.

CRS credit for mapping ice jam hazards is based upon the use of historic ice jam records to determine flood heights. Regulatory credit is provided for managing floodplain development to these flood heights and designating areas where moving ice floes can be hazardous.

d. Flood Hazards Affected by Land Subsidence

Subsidence of the land surface affects flooding and flood damage. It occurs in at least 38 states. Although there are no national statistics for increased flood damage due to subsidence, this hazard can increase flood damage to entire communities that are subject to coastal flooding, and it threatens both larger and smaller areas elsewhere. Because the causes of subsidence vary, selected mitigation techniques are required in different situations.

e. Dunes and Beaches

Coastal dunes and beaches provide protection to inland development. They are barriers that break up waves and dissipate the effects of hurricanes and coastal storms. Their preservation is important to protect property from damage and destruction by coastal flooding.

Beaches and dunes are by nature dynamic, shaped by natural movements of sand, wind, storms, currents, and seasonal changes. They can absorb storm energy and they are replenished during calm weather. However, sea level rise, subsidence, and human development threaten them. Once development takes place, property owners naturally want protection. “Hard” structures attempt to stop the natural movements of beaches and sand dunes and can increase the damage to the human and natural environments over the years.

The CRS therefore credits protecting and preserving areas with coastal dunes and beaches. Credit is provided for preserving these areas as open space and for regulating traffic and development on them.

f. Mudflow Hazards

Because of unresolved problems associated with defining mudflows and differentiating them from other types of landslides, less CRS credit is provided for regulating mudflow hazards than for the other special hazards. Full CRS credit is provided for mapping and open space, however.

g. Coastal Erosion

Estimates are that 24% of the Atlantic, Pacific, Gulf of Mexico, and Great Lakes coasts face significant erosion. Erosion occurs to properties in the coastal floodplain and to properties on bluffs above the floodplain. The CRS provides credit to encourage communities to undertake programs to minimize those problems.

The community must map the erosion-prone area or erosion rates and receive minimum credit for coastal erosion regulations under Section 431SH.g in order to receive other special hazards credit for erosion management activities.

If the community maps the erosion-prone area or erosion rates and receives minimum credit for coastal erosion regulations under Section 430SH.g, then special hazard credit points are provided for:

- mapping erosion-prone areas (Section 410SH),
- regulating floodprone areas (Section 430SH),
- maintaining data on shoreline erosion (Section 440SH), and
- maintaining programs that affect the rate of erosion, such as bluff stabilization and beach nourishment (Section 540SH).

It should be noted that the CRS does not provide credit for structural flood control projects that can result in a revision to the Flood Insurance Rate Map (FIRM). Similarly, the CRS does not provide credit for structures that may be installed to affect erosion rates. If a seawall, revetment, breakwater, or other structure is built to arrest erosion, then the effect of the structure should be shown on the erosion-prone area map or in the area's erosion rates.

However, Section 540SH provides credit to encourage maintenance of erosion protection programs, such as beach nourishment and sand dune restoration, that are not reflected on a FIRM or erosion-prone area map.

Communities are encouraged to prepare and adopt coastal erosion management plans that guide land use development, redevelopment, post-disaster recovery, and mitigation decisions. Credit for preparing, adopting, implementing, evaluating, and updating such a plan could be credited under Activity 510 (Floodplain Management Planning).

A community's erosion management program should include other activities that may not be recognized under the special hazards credit. For example, post-disaster recovery and mitigation policies might require storm-damaged areas to be redeveloped with new street patterns to accommodate the clustering of structures away from high hazard areas. Additionally, projects credited under Activity 330 (Outreach Projects) should include information on the erosion hazard as well as the flood hazard. Activity 340 (Flood Hazard Disclosure) provides CRS credits if real estate agents advise property purchasers of the erosion hazard (DOH (Disclosure of Other Hazards)).

h. Tsunamis

A tsunami is a wave or series of waves generated at sea or near shore by an earthquake, volcano, or landslide. Tsunami is a Japanese word for "harbor wave." Sometimes the same phenomenon is called a seismic sea wave or tidal wave, although a tsunami is not formed by tidal action.

By whatever name, tsunamis are well known for the destruction they can cause. They can move as fast as 1,000 kilometers per hour from their point of origin, usually in the Pacific Ocean. They are hard to recognize at sea but when they reach shallow water, the wave builds up. The effect is more like a rise in sea level than a breaking wave. In narrow areas, where water is concentrated, the resulting water level can be very high, in some areas as much as 20 or 30 feet above normal tides.

Because most tsunamis are seismic in origin, their occurrence in the Atlantic Ocean or Gulf of Mexico would be rare. Therefore, CRS credit for tsunami programs is limited to communities on the Pacific and Caribbean coast, i.e., those shoreline communities in Alaska, Hawaii, Washington, Oregon, California, the Pacific islands, Puerto Rico and the Virgin Islands.

In addition to these special hazard credits in Activities 410, 420, and 430, communities should incorporate the tsunami hazard into their public information (Activity 330), flood hazard disclosure (Activity 340), and flood warning programs (Activity 610). The hazard should be considered in the preparation of a floodplain management or repetitive loss plan (Activities 240 and 510).

> In addition to the credits provided in this *Supplement*, a community may receive credit for including tsunami information in its outreach projects. Although tsunamis are not listed in Activity 330 in the *CRS Coordinator's Manual*, a community may consider discussions on the tsunami hazard and protection measures as an eleventh topic and receive the appropriate credit points for its outreach projects.

402SH For More Information

a. The following papers provide background discussion for the individual special hazards. They are available at no cost (see Appendix E of the *CRS Coordinator's Manual*).

CRS Credit for Management of Uncertain Flow Path Hazards.
CRS Credit for Management of Areas Adjacent to Closed Basin Lakes.
CRS Credit for Management of Floodprone Areas Subject to Land Subsidence.
CRS Credit for Management of Ice Jam Hazards.
CRS Credit for Management of Pacific and Caribbean Tsunami Hazards.

b. The following report is available from:

National Academy Press
2101 Constitution Avenue, N.W.
Box 285
Washington, D.C. 20055
1-800-624-6242
http://www.nap.edu

Alluvial Fan Flooding, National Research Council, 1996.

410SH ADDITIONAL FLOOD DATA IN SPECIAL HAZARD AREAS

Mapping criteria for special hazard areas are discussed in this section. For areas that meet the mapping criteria, credit is provided in Activity 410. All special hazards credits are provided only if those areas are mapped by methods described in this section.

NOTE: *This section is a supplement to Activity 410 (Additional Flood Data) in the* ***CRS Coordinator's Manual****. Much of the discussion in this section relies on Activity 410. Please read that section before proceeding. Complete Activity Worksheet AW-410SH for each special hazard area and transfer the results to AW-410.*

Credit for mapping special hazard areas for management purposes is provided in Activity 410SH if floodplain maps and flood data for those areas are developed according to the standards discussed in this section. Credit for open space preservation in special hazard areas mapped according to these standards is increased by almost 50% in Section 420SH. Credit for management of special hazard areas mapped according to these standards is provided in Section 430SH.

For many reasons, the maps developed by FEMA and published as FIRMs did not adequately define all of the risks and hazard areas associated with flooding. For example, there are stream reaches where the 100-year flood elevation, based upon flow records, is lower than more frequent floods caused by ice jams. In other areas, sediment transport was not adequately considered. Mapping the flood hazards based upon today's conditions in an area where the land is subsiding may not protect future development.

Each of the special hazards has mapping criteria described in Section 411SH. As with all mapping credits discussed in Activity 410 in the *Coordinator's Manual*, areas for which credit is requested for open space preservation or regulation of special hazards must be shown on the Impact Adjustment Map.

Areas for which most special hazards regulation credit is requested may be within the Special Flood Hazard Area (SFHA) or outside of it. But all areas for which credit is requested must be included in the area of the regulatory floodplain (aRF) for calculation of all CRS credits.

The special hazard areas that have been studied according to the criteria described in this section are designated on the community's Impact Adjustment Map (see Section 400 in the *Coordinator's Manual*). These hazards are designated:

Uncertain flow path hazards: UF	Flooding affected by land subsidence: SU
Closed basin lakes: CB	Dunes and beaches: DB
Ice jam hazards: IJ	Mudflow hazards: MF
Coastal erosion: CE	Tsunamis: TS

411SH Credit Points

Credit for management of a special hazard is only given if the area mapped is subject to regulation under Section 431SH, unless the entire special hazard area is preserved as open space. The area for which credit is requested must include only that area in which flooding is caused by or increased by the special hazard. The Impact Adjustment Map, if one is provided, must show the area subject to surface water flooding due to the hazard.

For example, even if an entire community has a subsidence problem, the area given regulatory credit for SU (Section 430SH) may include only areas where flooding results from, or is increased by, subsidence.

The credit calculations are recorded on Activity Worksheets AW-410SH and AW-411SH. The calculated credit for regulation of all special hazards is then transferred to AW-411 to calculate credit for all floodplain mapping.

a. Uncertain Flow Path Hazards

1. Prerequisites for mapping credit: To receive credit for mapping, open space preservation, and/or management of alluvial fan hazards (one type of uncertain flow path hazard), the community must either map alluvial fan areas in detail, accounting for the flood, sediment, debris, velocity, and avulsion hazards in the area, or it must require developers to do so as a condition of any development permit. The mapping technique must meet the criteria specified in *Flood Insurance Study Guidelines and Specifications for Study Contractors*.

2. RFEUF1 (Regulatory flood elevation) Credit for Uncertain Flow Path Hazards:

   a. Alluvial Fan Hazards

      (1) RFEUF1 credit of 50 points is provided for mapping alluvial fan hazards in areas outside the SFHA as shown on the community's FIRM.

      (2) RFEUF1 credit of 25 points is provided for mapping alluvial fan hazards within the SFHA as shown on the community's FIRM.

   b. Moveable Bed Stream Hazards:

      (1) RFEUF2 credit of 50 points is provided for moveable bed streams not studied in detail on the FIRM that meet the following study criteria:

(a) In the case of aggrading or degrading streams, a sediment transport model that includes the availability of sediment to the stream, and that accounts for its movement through the floodplain, is required. Modeling of these streams for CRS credit must look at present conditions and projections of future conditions based upon changes in the source of sediment and the floodplain. Mapping and management must be based upon the worst case of aggradation or degradation.

(b) In the case of channel migration, the local history of migration must be reflected in the mapping process. For full credit, mapping must be based upon floodplain soils and historic channel migration that indicates the probable extent of future migration.

(2) RFEUF3 credit of 25 points is provided for moveable bed streams not studied in detail on the FIRM that meet the study criteria of b(1)(a) or b(1)(b) above (studies required before development).

(a) In the case of aggrading or degrading streams, for permits for single structures the community may require only a statement from a registered professional engineer that the proposed structure is reasonably safe from the erosion- or sedimentation-related flood hazard.

(b) In the case of channel migration, credit is provided if a community uses a locally developed standard building setback for unstudied streams in lieu of a detailed study by a developer. Such a setback standard must be based upon data from the general area regulated.

Some areas of alluvial fans are undevelopable without major flood control structures to manage both the water and sediment. Other areas may be developed as safely as many riverine floodplain areas. The requirement for CRS credit for mapping, open space preservation, and/or management is to determine the TRUE risks on alluvial fans and regulate development accordingly.

One of the uncertainties about moveable bed streams concerns the changes in the stability of the channel over time. Throughout much of the arid and semi-arid regions of the United States, there is evidence that human activities over as short a time as a decade have drastically changed the nature of some streams. It is important to understand the causes of aggradation, degradation, and channel migration in order to project the future configuration of the channel.

b. Closed Basin Lakes

1. Prerequisites for mapping credit: To receive credit for mapping, open space preservation, and/or management of closed basin lakes, the community must identify the type of lake and establish regulatory flood elevations by means of a study that

addresses lake parameters such as type, topography, and statistical data. These regulatory elevations should include appropriate freeboard to allow for windset, wave action, and ice.

The area subject to lake flooding must be mapped by projecting the closed basin flood elevation onto a topographic map in a manner similar to conventional floodplain mapping. These mapped areas are provided RFECB (regulatory flood elevation) credit.

The following mapping methods are acceptable for CRS credit for mapping: 1) stage-frequency analysis, 2) topographical analysis, 3) high water mark determinations, 4) water balance analysis, or 5) combinations of these methods. Any other method must be submitted to the FEMA Regional Office for approval. The area subject to closed basin lake flooding and the SFHA as shown on the FIRM should be shown on the same topographic base map.

2. RFECB (Regulatory flood elevation) Credit:

   a. RFECB credit of 50 points is provided for adopting a regulatory flood elevation based on a closed basin lake analysis in areas outside the SFHA as shown on the community's FIRM or in SFHAs where the FIRM did not provide a base flood elevation.

   b. RFECB credit of 25 points is provided for adopting a regulatory flood elevation based on a closed basin lake analysis in areas within the SFHA as shown on the community's FIRM.

c. Ice Jam Hazards

1. Prerequisites for mapping credit: To receive credit for mapping, open space preservation, and/or management of ice jam hazards, the community must establish flood elevations by means of a study of historic flooding due to ice jams for the reach(es) it manages. This study should include all ice jam elevation data. Methods discussed in Appendix 3 of *Flood Insurance Study Guidelines and Specifications for Study Contractors* are recommended for statistical analysis.

   The "ice jam elevation" must be either 1 foot above the elevation of record, or the 100-year elevation established by statistical analysis, provided that it is higher than the 100-year flood elevation used to determine the SFHA.

   The area subject to ice jam flooding is mapped by projecting the ice jam elevation onto a topographic map in a manner similar to conventional floodplain mapping. Mapping of areas subject to ice floes is based upon the largest area of historic floe movement.

If the regulated area is shown on the community's FIRM, a copy of the portion of the Flood Insurance Study that describes the methodology or other documentation must be provided to demonstrate that a higher standard was used.

If the area subject to ice floe damage is mapped, historic evidence of the ice floe hazard must be documented.

2. RFEIJ (Regulatory flood elevation) Credit:

   a. RFEIJ credit of 50 points is provided for mapping ice jam hazards in areas outside the SFHA as shown on the community's FIRM or in SFHAs where the FIRM did not provide a base flood elevation.

   b. RFEIJ credit of 25 points is provided for mapping ice jam hazards within the SFHA as shown on the community's FIRM. This credit is provided even if the SFHA was mapped according to the standards in Appendix 3 of the *Flood Insurance Study Guidelines and Specifications for Study Contractors*.

Ice jams can cause flood elevations significantly higher than clear water flooding does. A 10-year flood, in conjunction with an ice jam, can cause flood elevations many feet higher than a 100-year flood. Moving ice floes can be extremely damaging to structures and utilities.

Ice jams are not random in their occurrence. Channel configuration and stream slope combine to cause ice jams to recur at the same locations. Although statistical analysis of ice jams may be of limited value due to lack of data, regulation based upon the highest recorded ice jam elevation is better than regulation based on clear water flooding alone.

d. Flood Hazard Areas Affected by Land Subsidence

Subsidence may result in sudden, catastrophic collapses of the land surface or in a slow lowering of the land surface. In either case, it can cause increased hazards to structures and infrastructure. In some cases, the causes of subsidence can be controlled. In others, subsidence is a hazard to be mapped and avoided.

1. Prerequisites for mapping credit: To receive CRS credit for mapping, open space preservation, and/or management of areas of land subsidence where subsidence is due to the withdrawal of fluids or gasses, or is associated with organic soils, maps of future subsidence must be provided. The entire floodprone area subject to subsidence must be mapped. Credit is provided for mapped floodprone areas where the combination of historic and projected subsidence is greater than 1.0 foot.

   If the area subject to subsidence is shown on the community's FIRM, a copy of the portion of the Flood Insurance Study that describes the methodology or other documentation must be provided in order to receive CRS credit.

2. RFESU (Regulatory flood elevation) Credit:

   a. RFESU credit of 50 points is provided for the area outside the SFHA shown on the community's FIRM that is mapped as subject to subsidence.

   b. RFESU credit of 25 points is provided for areas inside the SFHA as shown on the community's FIRM that are mapped as subject to subsidence.

e. Dunes and Beaches

RFEDB (Regulatory flood elevation) Credit: RFEDB credit of 50 points is provided for mapping coastal dunes and beaches that are outside the SFHA as shown on the community's FIRM, but that are preserved as open space or regulated according to the standards in Section 431SH.e.

Coastal dunes and beaches are different from the other hazards discussed in this section: rather than posing a hazard, their protection provides safety for adjacent inland development.

f. Mudflow Hazards

1. Prerequisites for mapping credit: To receive credit for mapping, open space preservation, and/or management of mudflow hazards, the community must designate mudflow hazards, geologic hazards, or other areas of hazard resulting from the mass movement of land due to inundation or saturation of surface and subsurface materials.

2. RFEMF (Regulatory flood elevation) Credit:

   a. RFEMF credit of 50 points is provided for mapping mudflow or landslide hazards outside the SFHA as shown on the community's FIRM if the scale of the mapping is 1:10,000 or smaller.

   b. RFEMF credit of 25 points is provided for mapping mudflow or landslide hazards within the SFHA as shown on the community's FIRM if the scale of the mapping is 1:10,000 or smaller.

g. Coastal Erosion-Prone Areas

1. Prerequisites for mapping credit: To receive credit for coastal erosion management programs under other activities, the "coastal erosion-prone area" must be identified. The coastal erosion-prone area is the coastal area where waves are anticipated to cause significant erosion and shoreline retreat within the next 30–100 years. The coastal erosion-prone area must be identified based on mapping or erosion rates that meet FEMA's minimum mapping standards. In the absence of FEMA standards, the mapping must be consistent with state coastal mapping standards.

2. RFECE (Regulatory flood elevation) Credit:

   a. RFECE credit of 50 points is provided for mapping the annual erosion rates of the community's shoreline subject to erosion.

   b. RFECE credit of 25 points is provided if the community requires a site-specific erosion rate analysis to be done at the time of application for development permits within 600 feet of a shoreline subject to erosion.

   c. RFECE credit of 25 points is provided if the community adopts a regulatory map delineating the areas affected by erosion over the next 30–100 years without showing specific erosion rates.

As of the publication date of this edition of the *Supplement*, there were no official FEMA mapping standards for coastal erosion. Therefore, communities may use maps or rates prepared by the state coastal management agency. If there are no state erosion maps or rates, the community may use those prepared by the U.S. Army Corps of Engineers, the U.S. Geological Survey, or other federal agency, or develop their own maps or rates. If there are no state or federal maps or rates, the community must document that the maps or rates it uses are consistent with state standards.

h. Tsunamis

1. Prerequisites for mapping credit: To receive credit for mapping, open space preservation, and/or management of tsunami hazards, the community must identify the areas subject to tsunami wave force and inundation. The extent of the tsunami hazard zone must be based on historical observations, credible models, or geological evidence coupled with mathematical models.

2. RFETS (Regulatory flood elevation) Credit:

   RFETS credit of 50 points is provided for adopting a regulatory flood elevation based on the maximum observed or calculated tsunami runup. This credit is provided even where base flood elevations are provided on the Flood Insurance Rate Map.

To receive the mapping credit under Activity 410SH, the community must have a map of the tsunami hazard areas. Case-by-case or site-specific analyses are not credited. The study must account for the coastline configuration and depth of water. More information on tsunami mapping techniques can be found in the text and references in *CRS Credit for Management of Pacific and Caribbean Tsunami Hazards* (see Appendix E of the *CRS Coordinator's Manual*).

412SH Impact Adjustment

a. Except for coastal erosion, the methods used to determine impact adjustment ratios in Section 412 of the *Coordinator's Manual* apply to mapping of the special hazards. Please refer to that section.

b. Communities that have mapped erosion-prone areas or rates along their entire shoreline should use Option 1 for their impact adjustment. If the entire erosion-prone shoreline is not mapped showing erosion-prone areas or rates, the community must use Option 2 for the impact adjustment.

Where different mapping or regulatory standards apply, each area must be shown on the Impact Adjustment Map and measured to determine its impact adjustment ratio.

If the community has erosion rate maps for all of its shoreline subject to erosion, then the impact adjustment would use Option 1 and rAFDSH = 1.0. If the community does not map and regulate the entire erosion-prone area, it must use Option 2 for an impact adjustment and rAFDSH = 0.25.

413SH Credit Calculation

The credit for mapping special hazard areas is calculated on Activity Worksheets AW-410SH and AW-411SH, which are attached to this *Supplement.*

414SH Credit Documentation

The documentation required for special hazards mapping credit must show how the mapping addresses the special hazard mapping criteria described in this section.

The community must provide the following:

a. A map that shows the special hazard areas and the other floodplains (SFHA) in the community. If only a small area of the community is mapped for special hazards, only the SFHA in those areas need be shown on the map.

b. A description of the method used for the mapping that shows that it gets significantly different results when compared to standard riverine or coastal floodplain mapping.

c. Credit for 410SH is only provided if the mapping is used for land use regulation to prevent damage from the special hazard. The documentation required for Activity 430SH will meet this requirement.

415SH For More Information

a. The following papers provide background discussion for the individual special hazards. They are available at no cost (see Appendix E of the *Coordinator's Manual*).

CRS Credit for Management of Uncertain Flow Path Hazards.
CRS Credit for Management of Areas Adjacent to Closed Basin Lakes.
CRS Credit for Management of Floodprone Areas Subject to Land Subsidence.
CRS Credit for Management of Ice Jam Hazards.
CRS Credit for Management of Pacific and Caribbean Tsunami Hazards.

b. The following publication may be obtained from

FEMA Distribution Center
P.O. Box 2010
Jessup, MD 20794-2012
1-800-480-2520
Fax: (301) 362-5335

Flood Insurance Study Guidelines and Specifications for Study Contractors, FEMA-37, March 1993.

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420SH OPEN SPACE PRESERVATION IN SPECIAL HAZARD AREAS

This activity provides credit for having floodprone property within a designated special hazard area preserved as publicly owned or controlled open space. This credit is in addition to the credit provided for open space (OS) in Activity 420.

This credit is only provided for areas that receive credit in Activity 420 and, therefore, all of the requirements of Activity 420 apply. In addition, areas for which this credit is provided must be mapped as a special hazard area as provided in Section 410SH.

In Activity 410SH (Additional Flood Data for Special Hazard Areas), a community identifies special hazard areas and designates them on its Impact Adjustment Map (see Section 400 in the *Coordinator's Manual*). These hazards are designated:

Uncertain flow path hazards: UF
Closed basin lakes: CB
Ice jam hazards: IJ
Areas where flooding is affected by land subsidence: SU
Dunes and beaches: DB
Mudflow hazards: MF
Tsunamis: TS

There is no credit under this activity for open space in coastal erosion-prone areas because the primary effect of coastal erosion regulation in Activity 430SH is the preservation of open space. Therefore, it is credited in that activity.

421SH Credit Points

Preserved open space in special hazard areas (SHOS) (Maximum credit: 375 points)

Credit of 375 points is provided for that portion of the regulatory floodplain which receives credit for open space preservation in Activity 420 and which is also in an area designated as a special hazard area in Activity 410SH. To receive this open space credit, the community must also document that its special hazard area has been identified in accordance with the mapping criteria of Activity 410SH. There is no credit for this activity for open space in coastal erosion-prone areas.

The credit calculations are recorded on Activity Worksheet AW-420SH. The calculated credit for regulation of all special hazards is then transferred to AW-420 to calculate credit for all open space preservation.

422SH Impact Adjustment

Credit for open space preservation in special hazard areas is adjusted according to the portion of the total area of regulatory floodplain (aRF) in special hazard areas that is preserved as open space. The impact adjustment ratio for open space in special hazard areas is designated rSHOS.

a. Option 1: If all of the area in the regulatory floodplain is mapped as special hazard area(s) and all of the regulatory floodplain is preserved as open space, rSHOS = 1.0.

b. Option 2: If at least 5 acres of the regulatory floodplain are mapped as special hazard area(s) and preserved as open space, the community may use the default value for the impact adjustment ratio, rSHOS = 0.10.

c. Option 3: The size of the area of special hazard(s) that is preserved as open space must be determined in order to adjust the credit points. This impact is determined by dividing the area of special hazard(s) preserved as open space (aSHOS) by the total area of the regulatory floodplain (aRF).

   aSHOS = the total area of open space mapped according to the criteria in Section 410SH. If a portion of floodplain that is preserved as open space is mapped as being subject to two or more special hazards, the area is only counted once in the determination of aSHOS.

   $$rSHOS = \frac{aSHOS}{aRF}$$

As in Activity 420 (see the *Coordinator's Manual*), the credit for SHOS is adjusted according to the portion of the regulatory floodplain that is affected.

Example 422SH.c-1. The area of Floodville's special hazard open space (aSHOS) is the same as the area of open space subject to ice jams. As ice jams only occur on Foster Creek, aSHOS is the area of open space in the Foster Creek floodplain. As shown in Figure 420-1 in the *Coordinator's Manual*, this is the 80 floodprone acres in Foster Creek Park. aSHOS = 80 acres. The area of Floodville's regulatory floodplain (aRF) is 396 acres.

aSHOS = 80 aRF = 396

$$rSHOS = \frac{aSHOS}{aRF} = \frac{80}{396} = 0.20$$

423SH Credit Calculation

cSHOS = 375 x rSHOS

This value is calculated on AW-420SH and transferred to AW-421.

Example 423SH-1. Floodville calculates its credit for open space preservation within its area of ice jam hazard on AW-420SH (see Figure 420SH-1):

cSHOS = 375 x rSHOS = 375 x 0.20 = 75

This value is transferred to AW-420 to calculate Floodville's credit for Activity 420 (see the *Coordinator's Manual*, Figure 420-2).

424SH Credit Documentation

The community must submit either of the following with its application:

a. Application for credit for Activity 410SH for the special hazard area, or

b. If the special hazard has already been mapped by FEMA on the FIRM, a copy of the section in the Flood Insurance Study or a brief discussion of the mapping technique(s) used to delineate the special hazard area(s). This discussion should clearly show that the criteria in Section 411SH are satisfied. Documentation under Section 411SH is not needed for areas to be credited as coastal dune and beach open space because the special hazard status will be field verified by the ISO/CRS Specialist.

No other documentation is required except that required for Activity 420 (Open Space Preservation) (see the *Coordinator's Manual*).

The documentation for Activity 410SH shows that the areas are in mapped special hazard areas. The documentation required for Activity 420 shows that the areas are preserved for open space.

420SH OPEN SPACE PRESERVATION IN SPECIAL HAZARD AREAS:

Community: Floodville

422SH Impact Adjustment:

a. Option 1: rSHOS = 1.0

b. Option 2: rSHOS = 0.10

c. Option 3:

aUFOS = ___

aCBOS = ___

aIJOS = 80

aSUOS = ___

aDBOS = ___

aMFOS = ___

aTSOS = ___

aSHOS total of above: aSHOS = ___

rSHOS = aSHOS 80 / aRF 396 rSHOS = 0.20

423SH Credit Calculation:

cSHOS = 375 x rSHOS 0.20 cSHOS = 75

Enter this value on AW-420.

424SH Credit Documentation:

The following documentation is attached to this worksheet:

___ a. Application for credit for Activity 410SH for the special hazard area, or

✓ b. If the special hazard has already been mapped by FEMA on the FIRM, a copy of the section in the Flood Insurance Study or a brief discussion of the mapping technique(s) used to delineate the special hazard area(s).

Activity Worksheet AW-420SH Edition: January 1999

Figure 420SH-1. Floodville's completed activity worksheet for special hazard open space (AW-420SH).

430SH REGULATION OF SPECIAL HAZARD AREAS

Credit is provided for regulating special hazard areas in a manner that recognizes those elements of the hazard not addressed by the NFIP minimum standards for floodplain management.

In Activity 410SH (Additional Flood Data for Special Hazard Areas), a community identifies special hazard areas and designates them on its Impact Adjustment Map, if appropriate. These hazards are designated:

Uncertain flow path hazards: UF
Closed basin lakes: CB
Ice jam hazards: IJ
Areas where flooding is affected by land subsidence: SU
Dunes and beaches: DB
Mudflow hazards: MF
Coastal erosion: CE
Tsunamis: TS

In this activity, credit is provided for regulatory standards within those special hazard areas that mitigate the effects of the special hazards. This credit is in addition to credit provided for other regulatory standards under Activity 430 in the *Coordinator's Manual*.

For example, if a community identifies a lake as having the characteristics of a closed basin lake (having the potential for flooding of long duration at or above the base flood elevation) and maps its floodplain according to the criteria in Section 411SH, it may request credit under this activity for regulatory standards that mitigate problems from that situation. These regulatory standards are discussed in Section 431SH, below.

Example 430SH-1. The Village of Lakeside experienced lake elevations as much as 3 feet higher than the base flood elevation shown on its FIRM from April 1995 through June 1996. In March 1996, wind-driven ice floes destroyed structures as much as 4 feet above the base flood elevation. These flood levels were higher than any previous high water marks adjacent to the lake.

After these events, the state performed a stage-frequency analysis and recommended a regulatory flood elevation 5 feet above the base flood elevation. The Village adopted an ordinance requiring new structures to be elevated 5 feet above the base flood elevation, with utilities and access protected to the same elevation.

Since this elevation standard meets the criteria for mapping closed basin lakes (see Section 411SH.b), Lakeside requests credit under this activity, and also receives credit for special hazards mapping (411SH.b) and freeboard (FRB) in Activity 430.

431SH Credit Points

Maximum credit for Activity 430SH: 370 points.

Management credit for standards or criteria for each special hazard is specified below.

Data are entered on Activity Worksheets AW-430SH through AW-432SH (and AW-433SH, if applicable). The total credit for regulation of all special hazards is then transferred to AW-431 to calculate credit for all regulatory standards that exceed the NFIP minimum requirements.

a. Uncertain Flow Path Hazards

Uncertain flow path regulations (UFR) (Maximum credit: 100 points)

A community may receive credit for four types of uncertain flow path hazards: alluvial fans, aggrading stream channels, degrading stream channels, and migrating stream channels. Credit for only one type of uncertain flow path hazard is allowed in a particular area. For each stream reach or area, the community should seek credit for the one that gives the highest credit for UFR.

1. Credit is provided for regulating development in areas subject to alluvial fan hazards based upon the hazards from flood water, sediment and debris, and velocities that have been mapped in accordance with the criteria of Section 411SH.a. For alluvial fans, credit for UFR1 is the sum of the following:

   a. 80 points, if all new structures are required to be protected from alluvial fan hazards; or

      40 points, if all new structures are required to be built on protected fill at or above the regulatory flood elevation based on water and sediment;

   b. 10 points, if all utilities are required to be designed to function and minimize damage during the 100-year event; and

   c. 10 points, if access is required during the 100-year event.

2. Credit is provided for regulating development in areas subject to moveable bed stream hazards that have been mapped in accordance with the criteria of Section 411.a.

   a. In the case of aggrading streams, UFR2 credit is provided for management of future development to the worst case regulatory flood elevation. The minimum

area to be regulated must be the area inundated by that flood. UFR2 credit is the total of the following:

(1) 50 points, if new residential structures are required to be elevated to the worst case regulatory flood elevation;

(2) 20 points, if new non-residential structures are required to be elevated or floodproofed to the worst case regulatory flood elevation;

(3) 20 points, if public improvements and utilities are required to be protected from the worst case regulatory flood elevation; and

(4) 10 points, if protection is required to at least 1 foot above the worst case regulatory flood elevation. This credit is in addition to appropriate FRB credit in Activity 430.

b. In the case of degrading streams, UFR3 credit is given for management of future development within the floodplain inundated by the worst case of the base flood (probably the present channel condition) and to the regulatory flood elevation. Channel developments would be regulated based upon the channel condition during that worst case flood. UFR3 credit is the total of the following:

(1) 50 points, if new structures within 200 feet of the banks are required to have engineered foundations; and

(2) 50 points, if public improvements and utilities within the floodplain are required to be designed to withstand the worst case base flood and channel conditions.

c. In the case of streams subject to channel migration, UFR4 credit is provided for appropriate management of future development in the stream reaches subject to channel migration. UFR4 credit is:

(1) 100 points, if a detailed study of the migration potential has been mapped, and if all public and private developments are required to be located and designed to be safe from channel migration; OR

(2) 50 points, if a standard setback is mapped, and all public and private development is permitted only after a detailed study of the channel migration hazard.

Communities may regulate as local conditions require, but they must be able to demonstrate that their regulatory standards address all of the alluvial fan hazards listed. Additional documentation on the effectiveness of standards may be required during the verification process.

Credit for the three types of moveable bed streams is mutually exclusive, and exclusive of alluvial fan areas. If the mapping process indicates that the nature of the stream changes over time (for example, the channel degrades for a period and then aggrades over another period), the community must demonstrate that its regulation addresses the "worst case" of flood hazard over the entire period.

"Worst case" for purposes of this element means the worst hazard over the period of the mapping study. If, for example, a stream is shown to be aggrading, the worst case might be a combination of unstable vertical banks today, requiring a setback, and a higher flood elevation in the future, requiring higher floor elevations. In the case of a degrading channel, the worst case is the present flood elevation and future unstable banks or channel migration.

b. Closed Basin Lakes

Closed basin lake regulations (CBR) (Maximum credit: 100 points)

Credit is provided for regulating development in the area subject to closed basin flooding based upon the regulatory flood elevation that was calculated in accordance with the criteria of Section 411SH.b. Credit for CBR is the sum of the following:

1. 60 points, if new structures are required to be built on fill at or above the regulatory flood elevation;

2. 10 points, if access is required at the regulatory flood elevation;

3. 10 points, if all utilities are required to be protected to the regulatory flood elevation and functional during the regulatory event;

4. 15 points, if all utilities and basements within 1,000 feet of the shoreline established by the regulatory flood elevation are required to be floodproofed to the regulatory flood elevation unless it can be demonstrated that the water table under the proposed development will not be affected by lake elevations; and

5. 5 points, if new wells constructed within the hazard area are required to be floodproofed to the regulatory flood elevation, and all existing wells that are to be abandoned are required to be sealed to eliminate the mixing of groundwater and lake water.

If there are state standards for regulation of closed basin lakes, communities should work with the states to document the standards. States can work with the ISO/CRS Specialists before their visits to the communities to facilitate verification.

c. Ice Jam Hazards

Ice jam regulations (IJR) (Maximum credit: 100 points)

Credit is provided for regulating areas subject to ice jam hazards that have been mapped in accordance with the criteria of Section 411SH.c. Credit for IJR is the sum of the following:

1. 50 points for requiring new structures to be constructed on engineered fill or engineered pilings at or above the ice jam regulatory flood elevation;
2. 12 points x freeboard above the ice jam regulatory flood elevation (in feet) (maximum credit = 36 points for 3 feet of freeboard); and
3. 14 points for prohibiting new structures in areas subject to ice floe damage IN ADDITION TO credit for open space preservation.

As in the credit for FDN in Section 431 in the *Coordinator's Manual*, it is not necessary for each structure to be engineered. If the community or the state has standard specifications that are certified by an engineer, and the community's permit process ensures compliance with those specifications, the credit is provided.

Example 431SH.c-1. Floodville regulates the Foster Creek floodplain for ice jam hazards. The City requires the lowest floors of new buildings to be elevated at least 3 feet above the highest recorded ice jam elevation: IJR = 36.

d. Land Subsidence

Land subsidence regulations (SUR) (Maximum credit: 100 points)

Credit is provided for regulating development in the floodprone areas subject to land subsidence based upon the regulatory flood elevation considering subsidence as determined in accordance with the criteria of Section 411SH.d. Credit for SUR is the sum of the following:

1. 60 points, if all new and substantially improved residential structures are required to be built at or above the regulatory flood elevation;
2. 20 points, if all new and substantially improved non-residential structures are required to be built or floodproofed at or above the regulatory flood elevation; and
3. 20 points, if all new public facilities and utilities are required to be designed for the subsidence hazard.

Where land subsidence is the result of the withdrawal of fluids or gasses, or associated with organic soils, full credit is given for mapping the ultimate amount of subsidence, and the following adjustment used for other time periods:

Period of projection: Psu (years).

If Psu is greater than 100, use Psu = 100. There is no credit for projections less than 25 years.

For subsidence due to other causes, Psu = 100.

e. Dunes and Beaches

Coastal dune and beach regulations (DBR) (Maximum credit: 100 points)

Credit is provided for regulating development in coastal dune and beach areas as determined in accordance with the criteria of Section 411.e. DBR is the total of the following points:

1. 40, for regulations that prohibit vehicular and pedestrian traffic on sand dunes except on appropriate access structures.

2. 20, for regulations in effect outside of V Zones that prohibit human-made alterations of sand dunes that would increase potential flood damage.

3. 20, for regulations that require piles and other foundations to be protected from undermining due to erosion or scour. Such regulations must be consistent with the guidance in FEMA's *Coastal Construction Manual*.

4. 10, for regulations that prohibit development seaward (or lakeward) of existing buildings on waterfront properties. This includes swimming pools, pavilions, and landscaping material that can become debris during a storm and damage buildings.

5. 10, for regulations that require protection of mechanical and utility components and connections from the impacts of wind, water, and waves.

This element credits regulatory approaches peculiar to coastal areas. One common coastal regulation is a setback or coastal construction control line that prohibits construction in the area closest to the shore. The CRS considers such regulations as "prohibitory development regulations" and credits them as open space preservation in Activity 420 and 420SH. Activity 420 provides more credit points than Activity 430 or 430SH.

Sand dunes are important in providing protection to buildings along the coast. They act as natural barriers to dissipate waves and protect backlying areas from flooding and erosion. Sand dune protection is credited in two ways: by prohibiting traffic that can wear down the dune and any vegetative cover that may be holding it in place, and by extending the NFIP's minimum V-Zone requirement for construction on dunes into the A Zone.

The NFIP regulations are not explicit about foundation protection in coastal areas. The standard design practice is to ensure protection against the combined impacts of water, wind, and waves. However, recent experiences, especially in sandy areas, have found buildings undermined by a combination of long term beach erosion and localized scour during coastal storms.

Pages 4-14 through 4-16 in the *Coastal Construction Manual* (1996 edition) discuss pile embedment. Regulations to protect piles and building foundations can set locally appropriate depths for piles (e.g., 5 or 10 feet below sea level) or require that an engineer sign off on each building's foundation design.

The last two regulatory approaches are also based on research findings after recent hurricanes and coastal storms. Much of the damage to coastal buildings was due to impact and debris from objects placed between the buildings and the ocean. Earthen fill presents problems of increased runup and wave ramping. For additional information on this problem, FEMA has published Technical Bulletin 5-93, *Free of Obstruction Requirements* (see Section 435SH).

Underground pipes, including mounded septic systems, are often exposed to damage by erosion. Storm damage also showed cases where utility conduits, panels, and meters increased the structural damage to the building. When hit by waves they pulled at the flooring or other part of the building. Even though the floor was above the waves, it was damaged because of its connection to the utilities. All of these problems should be prevented with careful consideration to protecting the mechanical and utility components and connections.

Example 431SH.e-1. Gulf Beach County has regulations that meet the credit criteria for all items except for prohibiting development seaward of existing waterfront buildings. The regulation requiring a geotechnical certification reads:

> As a condition for a permit for new construction and substantial improvement to existing buildings seaward of Ocean Boulevard, the applicant shall provide a certification from a registered professional geologist or engineer based on the findings of a geotechnical report. The certification shall demonstrate that the piles, columns, shear walls, or other foundational elements will not be undermined or otherwise become unstable from wind and water forces during the base flood and the combined effects of overall beach profile erosion and localized scour. The certification shall take into account increased vertical erosion potential over time due to long term shoreline recession.

DBR = 40 + 20 + 20 + 0 + 10 = 90

f. Mudflow Hazards

Mudflow regulations (MFR) (Maximum credit: 35 points)

Credit is provided for regulating development in areas subject to mudflow hazards as mapped in accordance with the criteria in Section 411.f. Credit for MFR is the sum of the following:

1. 20 points, if a study by a soils engineer and/or an engineering geologist is required for any hillside grading where stability will be lessened by the grading, and at historic or prehistoric landslide sites;

2. 5 points, if where buildings are to be supported on stilts over a fill slope with a slope greater than two horizontal to one vertical: footings must extend at least 3 feet into the underlying bedrock, but not less than the depth required to resist the lateral load;

3. 5 points, if drainage from impervious surfaces must be collected and conducted to the street in a non-erosive manner; and

4. 5 points, if planting is required for erosion control.

g. Coastal Erosion

Coastal erosion regulations (CER) (Maximum credit 370 points)

1. Prerequisites for credit under this element:

   a. The regulations must be based on coastal erosion mapping developed in accordance with the criteria of Section 411SH.h, and

   b. In the 30-year erosion-prone area the regulations must prohibit all new buildings and substantial improvement of existing buildings.

2. CER = the total of the following points:

   a. The erosion protection level, in years, where new buildings are prohibited. CER has a range of from 30 to 100. The minimum value for CER is 30, i.e., the regulations meet the prerequisites listed above. The maximum value for CER is 100, i.e., the regulations prohibit all new buildings in the 100-year erosion-prone area.

   b. 0.5 x the number of years of erosion protection required by the setback regulations for structures that are substantially improved;

c. 0.5 x the number of years of erosion protection required by the setback regulations for structures that are substantially damaged;

d. 20 points if large buildings are required to meet a 60-year setback standard;

e. 75 points if erosion-threatened structures must be removed within two years of such designation by the state or local government. The regulation must require the structure to be moved within two years of receiving the erosion-threatened designation; identify erosion-threatened structures as those where any portion of the foundation sits within a zone of imminent collapse measured from a reference feature such as the first line of natural vegetation, or the normal high tide; and define the landward boundary of the zone as being measured from the reference feature a distance of at least five times the average annual long term erosion rate for the site plus 10 feet. Credit will only be awarded where a state or local government can show that the regulation has been upheld in court;

f. 50 points if hardened structures, such as seawalls, revetments, and large sandbags along the erodible shoreline, are prohibited; and

g. 25 points if all new structures must be set back at least 60 feet for the entire shoreline, including areas with accretion.

To receive credit for CER, the regulations must prohibit all new buildings from the area expected to erode over the next 30 years. If that is the only coastal erosion regulation enforced in the community, then CER = 30. Credit is provided for either local or state erosion management regulations as long as they are enforced within the community.

Additional credit is provided where regulations require substantially improved and/or substantially damaged structures to be set back at least 30 times the average annual erosion rate at the building site. The amount of credit is based on the number of years of erosion protection identified in the setback regulation. Credit is calculated by multiplying the number of years of protection by 0.5.

Example 430SH.g-1. Gulf Beach County uses the state's erosion rates and erosion-prone area maps. The county prohibits ALL new buildings and substantial improvements to existing buildings in the 30-year erosion-prone area. At a minimum, CER = 30 because the prerequisite prohibition in the 30-year erosion-prone area is met. The County receives additional credit for requiring substantially improved buildings to meet the 30-year setback:

CER = 30 + 15 = 45 points

30 for prohibiting all new buildings in the 30-year erosion-prone area.

15 for requiring substantially improved buildings to be set back out of the 30-year erosion protection level (0.5 x 30 = 15)

If the community requires all new and substantially improved large buildings (i.e., over 5,000 square feet) to be set back beyond the 60-year erosion protection line, additional credit is provided.

Communities that require the removal of erosion-threatened structures from the shoreline may receive 75 points. This regulation must specify how erosion-threatened structures will be designated and that upon such designation the property owner must move or demolish the structure within two years. Structures with any portion of the foundation in a zone of imminent collapse are considered to be erosion-threatened structures. The zone of imminent collapse extends landward from a reference feature identified in the regulation, usually the first line of natural vegetation, line of escarpment, or normal high tide line. At a minimum, the landward boundary of the zone must extend from the reference feature a distance of five times the average annual long term erosion rate for the site plus 10 feet. For example, if the erosion rate is 2 feet per year, the building must moved if it is located closer to the reference feature than 20 feet [(5 x 2 feet) + 10 feet = 20 feet]. Credit will only be awarded where a state or local government can show that the regulation has been upheld in court.

Permanent shoreline stabilization projects, such as, groins, jetties, bulkheads, seawalls, revetments, and large sandbags cause the loss of the public beach. They also increase erosion at adjacent properties by interrupting natural sand migration patterns. Communities that prohibit these types of hardened structures receive 50 points for CER credit.

h. Tsunamis

Tsunami regulations (TSR) (Maximum credit: 100 points)

Credit is provided for regulating development in the area subject to flooding by a tsunami based upon the regulatory flood elevation that was calculated in accordance with the criteria of Section 411.h. Credit for TSR is the sum of the following:

1. 60 points, if new structures are required to be built at or above the tsunami flood elevation, provided the tsunami flood elevation is higher than the base flood elevation;
2. 10 points, if fill and enclosed walls are prohibited for structural foundations in the tsunami hazard area;
3. 20 points, if public and high occupancy buildings are prohibited from the tsunami hazard area; and
4. 10 points, if buoyant and hazardous materials are prohibited from the tsunami hazard area.

i. Special Hazard Area Low Density Zoning

Special hazard area low density zoning (SHLZ) (Maximum credit: 340 points)

Within the special hazard areas, additional credit is provided for low density zoning. All credit criteria in Section 431LZ apply to this credit.

s = the minimum lot size in acres.

SHLZs = 34 x s

As in Section 431LZ of the *Coordinator's Manual*, for each different zoning district with a minimum lot size of 1 acre or more,

SHLZs = 34 x s, where s is the minimum lot size in acres.

s has a maximum value of 10.0, for minimum lot sizes of 10 acres or larger.

All conditions for the low density zoning element in Activity 430LZ (Higher Regulatory Standards) in the *Coordinator's Manual* apply to SHLZ credit. This has the result of increasing the credit for low density zoning in areas of special hazard within regulated floodplains.

All data for low density zoning in special hazard areas are entered on AW-433SH.

432SH Impact Adjustment

Regulatory credit is adjusted according to the area regulated to the criteria established in this activity as a portion of the total regulated floodplain. The impact adjustment ratio for each area of regulated special hazard is designated by a lower case "r" in front of the acronym for that regulated area (e.g., the impact adjustment ratio for the area credited for regulation for ice jam regulation is designated "rIJR"). In the following formulae, "XX" stands for the acronym for any of the special hazards.

a. Option 1:

1. If new development within the entire area of the regulated floodplain (aRF) is regulated to the same special hazard standards, and no credit was requested for OS in Activity 420, the impact adjustment ratio for that special hazard regulation credit is rXXR = 1.0.

2. If new development within the entire area of the regulated floodplain (aRF) is regulated to the same special hazard standards, and credit was requested for OS in Activity 420, the impact adjustment ratio for that special hazard regulation credit is rXXR = 1.0 - rOS.

b. Option 2:

If new development within part of the area of regulated floodplain (aRF) is regulated as a special hazard, a default value of 0.25 may be used for the impact adjustment ratio for that regulation (rXXR = 0.25).

If Option 2 is used, credit will be given for only one special hazard regulation.

c. Option 3:

The impact adjustment ratio for each area regulated for special hazards may be computed by dividing the area of regulation for each special hazard (aXXR) by the total area of regulated floodplain (aRF):

1. $rUFR = \frac{aUFR}{aRF}$ 2. $rCBR = \frac{aCBR}{aRF}$ 3. $rIJR = \frac{aIJR}{aRF}$

4. $rSUR = \frac{aSUR}{aRF}$ 5. $rDBR = \frac{aDBR}{aRF}$ 6. $rMFR = \frac{aMFR}{aRF}$

7. $rTSR = \frac{aTSR}{aRF}$

rSHLZs must be determined for each s (each different zoning district).

Areas credited as open space preservation (aOS) must be excluded from areas for which regulatory credit is requested (aXXR).

Communities that have mapped erosion-prone areas or rates along their entire shoreline should use Option 1 for their impact adjustment. If the entire erosion-prone shoreline is not mapped showing erosion-prone areas or rates, the community must use Option 2 for the impact adjustment.

Example 432SH-1. Gulf Beach County's dune regulations are in effect where there are sand dunes. The others are in effect for a 1/4 mile strip of land seaward of Ocean Boulevard. Since these areas comprise only a small part of all of the County's A and V Zones, it uses the default option. rDBR = 0.25. All of the County's erodible shoreline is subject to its erosion regulations, so Option 1 is used: rCER = 1.0.

Example 432SH-2. See Figure 420-1 in the *Coordinator's Manual*. Floodville's credit for ice jam regulation is effective throughout the Foster Creek floodplain. The area of the Foster Creek floodplain is 267 acres. However, the area of open space must be subtracted because it received credit in Section 420SH. The area of open space is 80 acres:

aIJR = 267 - aSHOS = 267 - 80 = 187; aRF = 396.

$$rIJR = \frac{187}{396} = 0.47$$

433SH Credit Calculation

Credit for SHR is transferred from Activity Worksheet AW-430SH to Section 433 on AW-430.

a. cUFR = UFR x rUFR b. cCBR = CBR x rCBR c. cIJR = IJR x rIJR

d. cSUR = SUR x rSUR e. cDBR = DBR x rDBR f. cMFR = MFR x rMFR

g. cCER = CER x rCER h. cTSR = TSR x rTSR

i. cSH = cUFR + cCBR + cIJR + cSUR + cDBR + cMFR + cCER + cTSR + cSHLZ

AW-430SH through AW-432SH are used to enter data and calculate credit. If credit is requested for low density zoning in special hazard areas, all data are entered on AW-433SH. The value for cSHLZ is computed on AW-433SH and entered on AW-432SH.

Example 433SH-1. Gulf Beach County's credit points are calculated as follows:

DBR = 90, rDBR = 0.25, cDBR = 90 x 0.25 = 22.5

CER = 60, rCER = 1.0, cCER = 60 x 1.0 = 60

cSH = 0 + 0 + 0 + 0 + 22.5 + 0 + 60 + 0 + 0 = 82.5

Gulf Beach County transfers 82.5 to AW-431.

Example 433SH-2. Floodville's credit points are calculated as follows:

IJR = 36 for requiring new construction to have the lowest floor 3 feet above the ice jam regulatory flood elevation.

rIJR = 0.47

cIJR = 36 x 0.47 = 16.92

cSH = 0 + 0 + 16.92 + 0 + 0 + 0 + 0 + 0 + 0 + 0 = 16.92

Floodville enters these values on AW-430SH-1, -2, and -3. The value for cSH is entered on AW-431 (see examples in Figure 430SH-1, -2 and -3, in this *Supplement* and in Figure 430-4 in the *Coordinator's Manual*).

434SH Credit Documentation

The community must provide the following documentation:

a. Either:

   1. Application for credit for Activity 410SH for the special hazard area, or

   2. If the special hazard has already been mapped by FEMA on the FIRM, a copy of the section in the Flood Insurance Study that discusses the mapping technique(s) used to delineate the special hazard area(s). This discussion should clearly show that the criteria in Section 411SH are satisfied.

b. The state or local law or ordinance language that adopts the regulatory standard. The appropriate acronym(s) (UF, CB, etc.) must be marked in the margin of the sections of the ordinance that apply to this activity.

A photocopy of the appropriate pages of the ordinance is sufficient and should be attached to the activity worksheet. The Chief Executive Officer's (CEO's) application certification is considered to include a certification that the ordinance or statute has been enacted into law and is being enforced (see Section 212.a in the *Coordinator's Manual*). The ordinance or law should either specify that the standard is to be used, or it must adopt the studies or maps for regulatory purposes.

The community must have the following documentation available to verify implementation of this activity:

c. [If Option 3 was used to determine the impact adjustment ratios] The Impact Adjustment Map prepared in accordance with Section 400. Each area listed in Section 431, Section 431LZ, and Section 431SH for which credit is being applied must be designated on the Impact Adjustment Map and in the map's key.

d. An explanation of the procedures followed for enforcement of the regulatory standard.

435SH For More Information

a. The following papers provide background discussion for the individual special hazards. They are available at no cost (see Appendix E of the *Coordinator's Manual*).

CRS Credit for Management of Uncertain Flow Path Hazards.
CRS Credit for Management of Areas Adjacent to Closed Basin Lakes.
CRS Credit for Management of Floodprone Areas Subject to Land Subsidence.
CRS Credit for Management of Ice Jam Hazards.
CRS Credit for Management of Pacific and Caribbean Tsunami Hazards.

b. The following publication may be obtained from

FEMA Distribution Center
P.O. Box 2010
Jessup, MD 20794-2012
1-800-480-2520
Fax: (301) 362-5335

Coastal Construction Manual, FEMA-55, February 1986.

Free-of-Obstruction Requirements, FIA-TB-5, April 1993.

430SH MAPPING AND REGULATION OF SPECIAL HAZARDS:

Community: Floodville

431SH Credit Points:

a. Alluvial fans (UFR1)
- Protection of new structures (80) _____
- Protected fill (40) _____
- Utilities protected (10) _____
- Access provided (10) _____

UFR1= total of above: UFR1 = _____

Aggrading streams (UFR2)
- Structures elevated (50) _____
- Non-residential structures (20) _____
- Utilities protected (20) _____
- Freeboard (10) _____

UFR2 = total of above: UFR2 = _____

Degrading streams (UFR3)
- Protection within 200 feet of bank (50) _____
- Floodplain protection (50) _____

UFR3 = total of above: UFR3 = _____

Migrating channels (UFR4) (100) UFR4 = _____

b. Closed basin lakes:
- Structures on fill (60) _____
- Access provided (10) _____
- Utilities protected (10) _____
- Floodproofing below water table (15) _____
- Well protection (5) _____

CBR = total of above: CBR = _____

c. Ice jam hazards:
- Engineered fill or pilings (50) _____
- Freeboard: (12 x freeboard) 36
- Ice floe area regulation (14) _____

IJR = total of above: IJR = 36

d. Land subsidence
- Residences elevated (60) _____
- Non-residential protected (20) _____
- Utilities protected (20) _____

Psu = _____

SUR = total of above x Psu _____ x Psu_____ =_____

Activity Worksheet AW-430SH Edition: January 1999

Figure 430SH-1. Floodville's completed activity worksheet for special hazard regulations (AW-430SH).

e. Dunes and beaches
- Prohibit traffic (40) _____
- Prohibit dune alterations (20) _____
- Foundation protection (20) _____
- Prohibit seaward projects (10) _____
- Utility protection (10) _____

DBR = total of above: DBR = _____

f. Mudflow hazards
- Engineering study (20) _____
- Stilts and footings (5) _____
- Drainage (5) _____
- Erosion control (5) _____

MFR = total of above: MFR = _____

g. Coastal erosion
- Protection level for prohibition (up to 100) _____
- Protection level for substantial improvements (up to 50) _____
- Protection level for substantial damage (up to 50) _____
- Protection of large buildings (20) _____
- Removal of threatened structures (75) _____
- Prohibit hardened structures (50) _____
- Overall setback (25) _____

CER = total of above: CER = _____

h. Tsunamis
- Elevate new structures (60) _____
- Prohibit fill and walls (10) _____
- Prohibit public buildings (20) _____
- Prohibit buoyant materials (10) _____

TSR = total of above: TSR = _____

j. Low density zoning credit is determined on AW-433SH.

432SH Impact Adjustment:

a. Option 1: rXXR = 1.0 or rXXR = 1.0 - rOS = _____

b. Option 2: rXXR = 0.25

c. Option 3:

1. rUFR1 = aUFR1 / aRF = _____
2. rUFR2 = aUFR2 / aRF = _____
3. rUFR3 = aUFR3 / aRF = _____
4. rUFR4 = aUFR4 / aRF = _____

Activity Worksheet AW-431SH Edition: January 1999

Figure 430SH-2. Page two of Floodville's completed activity worksheet for special hazard regulations (AW-431SH).

5. rCBR = aCBR ____ = _____ aRF ____

6. rIJR = aIJR 187 = 0.47 aRF 396

7. rSUR = aSUR ____ = _____ aRF ____

8. rDBR = aDBR _____ = _____ aRF _____

9. rMFR = aMFR ____ = _____ aRF ____

10. rTSR = aTSR _____ = _____ aRF _____

433SH Credit Calculation:

a. cUFR = (UFR1 ____ x rUFR1 ____) + (UFR2 ____ x rUFR2 ____) + (UFR3 ____ x rUFR3 ____) + (UFR4 ____ x rUFR4 ____) cUFR = _____

b. cCBR = CBR _____ x rCBR _____ cCBR = _____

c. cIJR = IJR 36 x rIJR 0.47 cIJR = 16.92

d. cSUR = SUR _____ x rSUR _____ cSUR = _____

e. cDBR = DBR _____ x rDBR _____ cDBR _____

f. cMFR = MFR _____ x rMFR _____ cMFR = _____

g. cCER = CER _____ x rCER _____ cCER = _____

h. cTSR = TSR _____ x rTSR _____ cTSR = _____

cSHLZ (From AW-433SH) cSHLZ = _____

i. cSH = total of above: cSH = 16.92

Enter the value for cSH on AW-431.

434SH Credit Documentation:

The following documentation is attached to this worksheet:

a. Either:

____ 1. Application for credit for Activity 410SH for the special hazard area, or

✓ 2. If the special hazard has already been mapped by FEMA on the FIRM, a copy of the section in the Flood Insurance Study that discusses the mapping technique(s) used to delineate the special hazard area(s).

✓ b. The ordinance(s) or law language that adopts the regulatory standard(s).

We will have the following documentation available to verify implementation of this activity:

✓ c. [If Option 3 was used to determine the impact adjustment ratios] The Impact Adjustment Map prepared in accordance with Section 400.

____ d. An explanation of the procedures followed for enforcement of the regulatory standard.

Activity Worksheet AW-432SH Edition: January 1999

Figure 430SH-3. Page three of Floodville's completed activity worksheet for special hazard regulations (AW-432SH).

440SH SPECIAL HAZARDS FLOOD DATA MAINTENANCE

441SH Credit Points

Erosion data maintenance (EDM) (Maximum credit: 20 points)

a. Prerequisites for credit under this element:

1. The community must update the erosion data on at least a five-year cycle.

2. The community must receive credit for regulating development in erosion-prone areas under Section 431SH.g, Coastal Erosion Regulations.

b. EDM = 20, if a state or local agency maintains reference marks spaced no more than ½mile apart and records shoreline erosion in relation to those reference marks at least every five years, OR

EDM = 10, if a state or local agency takes aerial photographs at least every five years to record and measure annual shoreline erosion.

This credit is for updating erosion data on at least a five-year cycle and adopting the new rates or maps as part of the community's erosion setback and coastal management regulations.

Example 441SH-1. (See Example 431.g-1) Gulf Beach County's state maintains reference marks spaced at 1,000-meter intervals along all beaches that are subject to erosion. The state records data at these sites every five years and provides its communities with revised erosion data a year later. Gulf Beach County uses these revised data for its regulatory program. EDM = 20

442SH Credit Calculation

There is no impact adjustment for this element. The points for EDM are recorded on the activity worksheet AW-440SH, and transferred to AW-440.

Example 442SH-1. Gulf Beach County's credit is recorded on AW-440SH (see Figure 440SH-1).

443SH Credit Documentation

The community must provide the following documentation:

a. A description of the method used to update mapped erosion rates or regulatory maps.

b. A certification that the rates or maps are updated and adopted on at least a five-year cycle.

440SH SPECIAL HAZARDS FLOOD DATA MAINTENANCE:

Community: Gulf Beach County

441SH Credit Points:

EDM = 20

442SH Credit Calculation:

c440SH = EDM 20

443SH Credit Documentation:

The following documentation is attached to this worksheet:

✓ a. A description of the method used to update mapped erosion rates or regulatory maps.

✓ b. A certification that the rates or maps are updated and adopted on at least a five-year cycle.

Activity Worksheet AW-440SH Edition: January 1999

Figure 440SH-1. Gulf Beach County's completed activity worksheet for special hazard flood data maintenance (AW-440SH).

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540SH SPECIAL HAZARD SYSTEM MAINTENANCE

This element credits programs that maintain measures that protect buildings from coastal flooding or erosion. These include dune or mangrove preservation, bluff stabilization, and beach nourishment programs. The applicant must submit a description of the program and identify where it is in effect on a map.

Credit for this element is dependent on the community having coastal erosion setback regulations. This is provided under Section 431SH.g. If CER = 0, then EPM = 0.

541SH Credit Points

Coastal erosion protection maintenance (EPM) (Maximum 30 points)

a. Prerequisites for credit under this element:

1. The community must have adopted a coastal hazard management plan that meets the planning process criteria in Activity 510 (Floodplain Management Planning).

2. The community must receive CER credit for regulating development in erosion-prone areas under Section 431SH.g, Coastal Erosion Regulations.

3. The erosion protection program must not adversely affect other properties.

4. The project must have been designed by a professional expert for the purpose of erosion management.

5. The program must have a secured source of funding and raw materials.

6. All required state and federal permits must have been obtained.

7. The program must provide protection from a Category 1 hurricane (including high tide and 1 foot of freeboard) and must be based on new sand being added to the area.

b. 1. EPM= 30 if the maintenance program is funded without any federal funds.

2. EPM= 15 if the maintenance program is partially supported with federal funds.

3. EPM= 0 if the maintenance program is funded entirely by federal funds.

This credit is for ongoing maintenance performed by a public, quasi-public, or non-profit agency, such as a property owners association. It is NOT for:

- Regulations that require individuals to maintain a program on their own properties,
- Maintenance of hard structural projects, or
- Implementation of one-time-only projects, such as a beach bulldozing project.

Example 541SH.b-1. Gulf Beach County has an ongoing beach nourishment program on the public beaches. Sand is imported each spring and placed in accordance with a plan developed with guidance from the state's coastal zone management office.

The program is funded by a motel occupancy tax. Under agreement with the Corps of Engineers, the county uses sand from spoil disposal sites created by dredging for navigation projects. Based on the frequency and volume of material from the navigation maintenance projects, the county and state have determined that this source of material is adequate for future nourishment projects. The project would not be over washed in a Category 1 hurricane. All local, state, and federal permits have been secured. EPM=15 because the program is supported by the Corps' navigation maintenance project.

542SH Impact Adjustment

a. Option 1:

If the maintained erosion protection measures cover the entire shoreline of the erosion-prone area, rEPM = 1.0.

b. Option 2:

If part of the erosion-prone shoreline is protected by one of the maintained programs, the community may use the default value for the impact adjustment ratio, rEPM = 0.20.

c. Option 3:

The impact adjustment for maintaining erosion protection programs is the total length of the shoreline protected by those programs divided by the total length of the shoreline in the erosion-prone area. Because these protection programs are linear features, area is not used as the basis for measurement.

$$rEPM = \frac{aEPM}{aEPS},$$

where aEPM = the length of the shoreline protected by the measures and aEPS = the total length of the shoreline in the erosion-prone area.

Option 3 produces the most accurate impact adjustment figures and in many cases, the results will be higher than those derived by using Option 2. However, it does require measuring the length of the shoreline affected.

Example 542SH.c-1. The total shoreline of Gulf Beach County's erosion-prone area is 18,200 feet long, aEPS = 18,200. The ongoing beach nourishment program is limited to the public beaches and affects 11,000 feet of that shoreline: aEPM = 11,000.

$$rEPM = \frac{11,000}{18,200} = 0.60$$

543SH Credit Calculation

cEPM = EPM x rEPM

Example 543SH-1. For Gulf Beach County:

EPM = 15, rEPM = 0.6, cEPM = 15 x 0.60 = 9

These points are entered on Activity Worksheet AW-540SH.

544SH Credit Documentation

The community must submit the following documentation with its application:

a. A description of the erosion protection maintenance program. The description must show that the program does not adversely affect other properties, that it was designed by a professional expert for the purposes of erosion management, and that all permits were obtained.

b. Documentation that shows how the community calculated the length of shoreline affected by the erosion protection program.

c. Documentation on the level of protection provided by the maintenance project.

d. A copy of the community's coastal hazard management plan with a description of the planning process.

e. Documentation of secured sources of funding for future maintenance work.

f. Documentation of secured sources of raw materials for future maintenance cycles.

One of the keys for crediting a maintenance program is that it must have been designed by a professional expert. Some communities have implemented projects on their beaches or dunes without careful design to ensure that they are effective.

The community must provide documentation of the level of protection provided by the project. This information should be in the design specifications for the project. The documentation should show that the project is maintained so that during the maintenance cycle, it would not be over washed during a Category 1 hurricane.

In determining the project elevation for this level of protection the community should use the maximum surge height (M.S.L.) from the National Weather Service's Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model. High tide and 1 foot of freeboard should be added to the Category 1 maximum surge height elevation to determine the appropriate protection level that must be obtained for EPM credit.

Because credit for coastal erosion regulations is a prerequisite for this credit, the community must have a map of the erosion-prone area. That map should be sufficient to show the shoreline subject to erosion and the portion that is covered by the program.

Documentation is needed that describes how the maintenance program will continue to be funded. Methods that depend on the legislative body's appropriating funds from general revenues are not adequate. There must be a dedicated source of revenue for the maintenance project, such as a room occupancy tax with receipts dedicated to the project. If a federal agency pays part of the cost, a copy of the continuing program authority is sufficient documentation.

Continued project maintenance is dependent on having future sources of material that are compatible with the beach. This should have been addressed in the feasibility study and should be included with the documentation for EPM credit.

540SH SPECIAL HAZARD SYSTEM MAINTENANCE:

Community: Gulf Beach County

NOTE: Review the prerequisites for credit for this activity in Sections 401SH.g and 541SH.a of *CRS Commentary Supplement for Special Hazards Credit*.

541SH Credit Points:

EPM = 15

542SH Impact Adjustment:

a. Option 1: rEPM = 1.0

b. Option 2: rEPM = 0.2

c. Option 3:

1. rEPM = aEPM 11000 = 0.60
   aEPS 18260

543SH Credit Calculation:

cEPM = EPM 15 x rEPM 0.60 = 9

544SH Credit Documentation:

The following documentation is attached to this worksheet:

✓ a. A description of the erosion protection maintenance program.

✓ b. Documentation that shows how the community calculated the length of shoreline affected by the erosion protection program.

✓ c. Documentation of the level of protection provided by the maintenance project.

✓ d. A copy of the community's coastal hazard management plan with a description of the planning process.

✓ e. Documentation of secured sources of funding for future maintenance work.

✓ f. Documentation of secured sources of raw materials for future maintenance cycles.

Activity Worksheet AW-540SH Edition: January 1999

Figure 540SH-1. Gulf Beach County's completed activity worksheet for special hazard system maintenance (AW-540SH).

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410 ADDITIONAL FLOOD DATA IN SPECIAL HAZARD AREAS

Community: _____

411SH Credit Points:

a. Uncertain Flow Path Hazards:

RFEUF1 RFEUF1 = _____

RFEUF2 (50) RFEUF2 = _____

RFEUF3 (25) RFEUF3 = _____

RFEUF4 (20) RFEUF4 = _____

b. Closed Basin Lakes

RFECB RFECB = _____

c. Ice Jam Hazards

RFEIJ RFEIJ = _____

d. Land Subsidence

RFESU RFESU = _____

e. Dunes and Beaches

RFEDB (50) RFEDB = _____

f. Mudflow Hazards

RFEMF RFEMF = _____

g. Coastal Erosion

RFECE RFECE = _____

h. Tsunami Hazards

RFETS RFETS = _____

412SH Impact Adjustment:

a. Option 1: rRFEUF1 = 1.0 rRFEUF2 = 1.0 rRFEUF3 = 1.0

rRFEUF4 = 1.0 rRFECB = 1.0 rRFEIJ = 1.0

rRFESU = 1.0 rRFEDB = 1.0 rRFEMF = 1.0

rRFECE = 1.0 rRFETS = 1.0

b. Option 2: rRFEUF1 = 0.10 rRFEUF2 = 0.10 rRFEUF3 = 0.10
rRFEUF4 = 0.10 rRFECB = 0.10 rRFEIJ = 0.10
rRFESU = 0.10 rRFEDB = 0.10 rRFEMF = 0.10
rRFECE = 0.10 rRFETS = 0.10

c. Option 3: rRFEUF1 = aRFEUF1 _____ = _____ rRFEUF2 = aRFEUF2 _____ = _____
aSFHA _____ aSFHA _____

rRFEUF3 = aRFEUF3 _____ = _____ rRFEUF4 = aRFEUF4 _____ = _____
aSFHA _____ aSFHA _____

rRFECB = aRFECB _____ = _____ rRFEIJ = aRFEIJ _____ = _____
aSFHA _____ aSFHA _____

rRFESU = aRFESU _____ = _____ rRFEDB = aRFEDB _____ = _____
aSFHA _____ aSFHA _____

rRFEMF = aRFEMF _____ = _____ rRFECE = aRFECE _____ = _____
aSFHA _____ aSFHA _____

rRFETS = aRFETS _____ = _____
aSFHA _____

413SH Credit Calculation:

a. cRFEUF1 = RFEUF1 _____ x rRFEUF1 _____ cRFEUF1 = ____
cRFEUF2 = RFEUF2 _____ x rRFEUF2 _____ cRFEUF2 = ____
cRFEUF3 = RFEUF3 _____ x rRFEUF3 _____ cRFEUF3 = ____
cRFEUF4 = RFEUF4 _____ x rRFEUF4 _____ cRFEUF4 = ____

b. cRFECB = RFECB _____ x rRFECB _____ cRFECB = _____

c. cRFEIJ = RFEIJ _____x rRFEIJ _____ cRFEIJ = _____

d. cRFESU = RFESU _____ x rRFESU _____ cRFESU = _____

e. cRFEDB = RFEDB _____ x rRFEDB _____ cRFEDB = _____

f. cRFEMF = RFEMF _____ x rRFEMF _____ cRFEMF = _____

g. cRFECE = RFECE _____ x rRFECE _____ cRFECE = _____

h. cRFETS = RFETS _____ x rRFETS _____ cRFETS = _____

i. Add lines a through h above: _____

c410SH = value above rounded to two decimal places: c410SH = _____

Enter this value on AW-410.

414SH Credit Documentation:

The following documentation is attached to this worksheet:

_____ a. A map that shows the special hazard areas and the other floodplains (SFHA) in the community. If only a small area of the community is mapped for special hazards, only the SFHA in those areas need be shown on the map.

____ b. A description of the method used for the mapping, which shows that it gets significantly different results when compared to standard riverine or coastal floodplain mapping.

____ c. Documentation that the mapping used for land use regulation is included in the documentation for Activity 430SH.

420SH OPEN SPACE PRESERVATION IN SPECIAL HAZARD AREAS:

Community: _____

422SH Impact Adjustment:

a. Option 1: rSHOS = 1.0

b. Option 2: rSHOS = 0.10

c. Option 3:

aUFOS = ____

aCBOS = ____

aIJOS = ____

aSUOS = ____

aDBOS = ____

aMFOS = ____

aTSOS = ____

aSHOS total of above: aSHOS = _____

rSHOS = aSHOS _____ rSHOS = _____
aRF _____

423SH Credit Calculation:

cSHOS = 375 x rSHOS _____ cSHOS = _____

Enter this value on AW-420.

424SH Credit Documentation:

The following documentation is attached to this worksheet:

_____ a. Application for credit for Activity 410SH for the special hazard area, or

_____ b. If the special hazard has already been mapped by FEMA on the FIRM, a copy of the section in the Flood Insurance Study or a brief discussion of the mapping technique(s) used to delineate the special hazard area(s).

430SH MAPPING AND REGULATION OF SPECIAL HAZARDS:

Community: _____

431SH Credit Points:

a. Alluvial fans (UFR1)
   - Protection of new structures (80) _____
   - Protected fill (40) _____
   - Utilities protected (10) _____
   - Access provided (10) _____

   UFR1= total of above: UFR1 = _____

   Aggrading streams (UFR2)
   - Structures elevated (50) _____
   - Non-residential structures (20) _____
   - Utilities protected (20) _____
   - Freeboard (10) _____

   UFR2 = total of above: UFR2 = _____

   Degrading streams (UFR3)
   - Protection within 200 feet of bank (50) _____
   - Floodplain protection (50) _____

   UFR3 = total of above: UFR3 = _____

   Migrating channels (UFR4) (100) UFR4 = _____

b. Closed basin lakes:
   - Structures on fill (60) _____
   - Access provided (10) _____
   - Utilities protected (10) _____
   - Floodproofing below water table (15) _____
   - Well protection (5) _____

   CBR = total of above: CBR = _____

c. Ice jam hazards:
   - Engineered fill or pilings (50) _____
   - Freeboard: (12 x freeboard) _____
   - Ice floe area regulation (14) _____

   IJR = total of above: IJR = _____

d. Land subsidence
   - Residences elevated (60) _____
   - Non-residential protected (20) _____
   - Utilities protected (20) _____

   Psu = _____

   SUR = total of above x Psu _____ x Psu_____ =_____

e. Dunes and beaches
Prohibit traffic (40) _____
Prohibit dune alterations (20) _____
Foundation protection (20) _____
Prohibit seaward projects (10) _____
Utility protection (10) _____

DBR = total of above: DBR = _____

f. Mudflow hazards
Engineering study (20) _____
Stilts and footings (5) _____
Drainage (5) _____
Erosion control (5) _____

MFR = total of above: MFR = _____

g. Coastal erosion
Protection level for prohibition (up to 100) _____
Protection level for substantial improvements (up to 50) _____
Protection level for substantial damage (up to 50) _____
Protection of large buildings (20) _____
Removal of threatened structures (75) _____
Prohibit hardened structures (50) _____
Overall setback (25) _____

CER = total of above: CER = _____

h. Tsunamis
Elevate new structures (60) _____
Prohibit fill and walls (10) _____
Prohibit public buildings (20) _____
Prohibit buoyant materials (10) _____

TSR = total of above: TSR = _____

j. Low density zoning credit is determined on AW-433SH.

432SH Impact Adjustment:

a. Option 1: rXXR = 1.0 or rXXR = 1.0 - rOS = _____

b. Option 2: rXXR = 0.25

c. Option 3:

1. rUFR1 = $\frac{\text{aUFR1}}{\text{aRF}}$ = _____
2. rUFR2 = $\frac{\text{aUFR2}}{\text{aRF}}$ = _____
3. rUFR3 = $\frac{\text{aUFR3}}{\text{aRF}}$ = _____
4. rUFR4 = $\frac{\text{aUFR4}}{\text{aRF}}$ = _____

5. rCBR = aCBR _____ / aRF _____ = _____

6. rIJR = aIJR _____ / aRF _____ = _____

7. rSUR = aSUR _____ / aRF _____ = _____

8. rDBR = aDBR _____ / aRF _____ = _____

9. rMFR = aMFR _____ / aRF _____ = _____

10. rTSR = aTSR _____ / aRF _____ = _____

433SH Credit Calculation:

a. cUFR = (UFR1 _____ x rUFR1 _____) + (UFR2 _____ x rUFR2 _____) +
(UFR3 _____ x rUFR3 _____) + (UFR4 _____ x rUFR4 _____) cUFR = _____

b. cCBR = CBR _____ x rCBR _____ cCBR = _____

c. cIJR = IJR _____ x rIJR _____ cIJR = _____

d. cSUR = SUR _____ x rSUR _____ cSUR = _____

e. cDBR = DBR _____ x rDBR _____ cDBR _____

f. cMFR = MFR _____ x rMFR _____ cMFR = _____

g. cCER = CER _____ x rCER _____ cCER = _____

h. cTSR = TSR _____ x rTSR _____ cTSR = _____

cSHLZ (From AW-433SH) cSHLZ = _____

i. cSH = total of above: cSH = _____

Enter the value for cSH on AW-431.

434SH Credit Documentation:

The following documentation is attached to this worksheet:

a. Either:

_____ 1. Application for credit for Activity 410SH for the special hazard area, or

_____ 2. If the special hazard has already been mapped by FEMA on the FIRM, a copy of the section in the Flood Insurance Study that discusses the mapping technique(s) used to delineate the special hazard area(s).

_____ b. The ordinance(s) or law language that adopts the regulatory standard(s).

We will have the following documentation available to verify implementation of this activity:

_____ c. [If Option 3 was used to determine the impact adjustment ratios] The Impact Adjustment Map prepared in accordance with Section 400.

_____ d. An explanation of the procedures followed for enforcement of the regulatory standard.

430SHLZ LOW DENSITY ZONING IN SPECIAL HAZARD AREAS:

Community: _____

431SHLZ Credit Points:

SHLZs = 34 x s, where s is the minimum lot size in acres.

a. SHLZ___ = 34 x ___ = _____

b. SHLZ___ = 34 x ___ = _____

c. SHLZ___ = 34 x ___ = _____

432SHLZ Impact Adjustment:

Each aSHLZs is the total area of all special hazards within the zoning district with a minimum lot size of s in acres.

a. rSHLZ___ = aSHLZ _____ = _____
aRF _____

b. rSHLZ___ = aSHLZ _____ = _____
aRF ____

c. rSHLZ___ = aSHLZ _____ = _____
aRF _____

433SHLZ Credit Points:

SHLZ___ _____ x rSHLZ___ _____ = _____

SHLZ___ _____ x rSHLZ___ _____ = _____

SHLZ___ _____ x rSHLZ___ _____ = _____

cSHLZ = total of above = _____

Enter the value of cSHLZ on AW-432SH.

440SH SPECIAL HAZARD FLOOD DATA MAINTENANCE:

Community: _____

441SH Credit Points:

EDM = _____

442SH Credit Calculation:

c440SH = EDM _____

443SH Credit Documentation:

The following documentation is attached to this worksheet:

_____ a. A description of the method used to update mapped erosion rates or regulatory maps.

_____ b. A certification that the rates or maps are updated and adopted on at least a five-year cycle.

540SH SPECIAL HAZARD SYSTEM MAINTENANCE:

Community: _____

NOTE: Review the prerequisites for credit for this activity in Sections 401SH.g and 541SH.a of *CRS Commentary Supplement for Special Hazards Credit*.

541SH Credit Points:

EPM = _____

542SH Impact Adjustment:

a. Option 1: rEPM = 1.0

b. Option 2: rEPM = 0.2

c. Option 3:

1. rEPM = $\frac{\text{aEPM}}{\text{aEPS}}$ = _____

543SH Credit Calculation:

cEPM = EPM _____ x rEPM _____ = _____

544SH Credit Documentation:

The following documentation is attached to this worksheet:

_____ a. A description of the erosion protection maintenance program.

_____ b. Documentation that shows how the community calculated the length of shoreline affected by the erosion protection program.

_____ c. Documentation on the level of protection provided by the maintenance project.

_____ d. A copy of the community's coastal hazard management plan with a description of the planning process.

_____ e. Documentation of secured sources of funding for future maintenance work.

_____ f. Documentation of secured sources of raw materials for future maintenance cycles.